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The Pennsylvania State University

The Graduate School

Department of Civil and Environmental Engineering

ISSUES SURROUNDING THE DESIGN/BUILD DELIVERY SYSTEM FOR CONSTRUCTION CONTRACTS

A Thesis in

Civil Engineering

by

Peter S. Lynch

Submitted in Partial Fulfillment

of the Requirements

for the Degree of

Master of Science

August 1995

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Abstract

This thesis evaluated the design/build delivery system by discussing issues which surround the contracting process and presenting viewpoints of various construction professionals. The information was compiled through an extensive literature search and through field inquiries with construction professionals currently engaged in design/build contracting ventures. The issues are presented chronologically in Chapters 2 and 3, and from the Federal Owner's perspective in Chapter 4. Chapter 5 briefly evaluates very complicated issues which surround the delivery system which involve financial concerns, insurance issues, legal concerns, subcontractor relationships and professional registration.

The primary purpose for this research was to consolidate the relevant issues surrounding the design/build delivery system into a single, organized document which may be used by construction professionals and/or owners who may be considering design/build contracting methods. The research may also be helpful as a foundation for more detailed research into specific elements of the contracting process.

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Chapter 1.

Introduction

Introduction

Many years ago, construction was completed when an owner commissioned a "Master Builder" to deliver a finished product for the owner's use. General parameters were specified by the owner and the master builder would create an appropriate set of plans, hire and pay the tradesmen, procure materials, sequence the work and supervise the construction. Pyramids, fortifications, castles and cathedrals were built this way for thousands of years. However, the master builder concept began to lose favor as construction designs became more complicated and owners grew concerned about the integrity of master builders. Owners began to hire an architect to design the project first, then bids were solicited from construction professionals who would ultimately build the facility. This Design/Bid/Build contracting method became the norm, and is now considered the "Traditional" delivery system.

A resurgence in the owner's desire for a single point of contact has taken place in the past twenty years. Today's design/build delivery system is analogous to the historic master builder philosophy. The modern version of the concept is surrounded by a variety of issues, some indicative of today's litigious society, some as old as the pyramids themselves.

Problem Statement

The design/build delivery system is a viable alternative for owners who desire the construction of new, or renovation of existing facilities. Specific advantages and

disadvantages of this contracting relationship are not yet clearly documented. Defining the basic issues and recognizing the associated risk is essential in order to sensibly employ this revitalized contracting option.

Objectives

The objective of this thesis is to define the basic issues of the design/build delivery system. The thesis will identify ways the industry is attempting to enhance the advantages while mitigating the disadvantages of design/build. Additionally, the allocation of risk associated with these issues is also addressed. Basic trends in the construction industry are presented, as are the opinions of current construction professionals regarding the most important issues.

Value of the Work

This thesis can be used by construction professionals to develop better contracts for design/build projects. This research will also help contract administrators become aware of the issues surrounding the design/build contracting process. Many contract administrators have not worked with design/build contracts; the basic awareness provided in this work can help administrators approach concerns with a better understanding of each party's perspective.

Additionally, this thesis can serve as a basis for subsequent research in the design/build process. Chapter six (6) includes a sample of the types of subsequent research which may be appropriate.

Methodology

To accomplish the stated objectives, a five step research methodology was employed.

1. *Literary search.* An extensive search of available literature was completed. Literature was limited primarily to periodicals, professional papers, government regulations and a few text books which addressed design/build contracts. The available material provided a basic understanding of the delivery system and identified issues relevant to the contracting process.

2. *Field inquiries.* With the basic knowledge obtained from the literature search, a questionnaire was developed for use during interviews with construction industry professionals. The questionnaire was used as a framework for the field inquiries. Professionals involved with the design/build process as designers, constructors and owners and from both the private and public sector were interviewed using the same questions. Appendix A is a listing of the field inquiries conducted and the questionnaire utilized.

A conscious effort was made not to limit the discussions only to the items included in the questionnaire. This freedom of dialog allowed for the gain of considerable insight from the current industry professionals on issues beyond those included in the questionnaire. The field inquiries provided a historical perspective, identified the key attributes of the delivery system and steps being taken to enhance the positive and mitigate the negative characteristics of the design/build delivery system.

3. *Synthesize data.* Upon substantial completion of both the literary search and field inquiries, the data was synthesized as follows:

   a. Sift useful information from superfluous information.
   b. Sort the useful information in a logical sequence.
   c. Partition the data into a framework.

4. *Categorize the issues.* The issues were categorized as follows:

    a. Pre-award issues.
    b. Post-award issues.
    c. Issues unique to federal contracts.
    d. Other issues including: registration, subcontracts, insurance, etc.

5. *Formulate conclusions.* The final step was to formulate conclusions.

Background

Despite the numerous possible contracting relationships which have been called design/build, this thesis defines design/build simply as a delivery system whereupon an owner contracts with a single entity for the complete design and construction of a facility. The contract may be for the renovation of an existing facility, or for a new building; but the common element is a single contract for the design and construction.

The design/build contractual relationship provides the owner with a single point of contact who is responsible for the entire construction process. This single point of contact should ease the owner's responsibility in contract administration and ensure a smooth, rapid transition between the design and construction phases of the project.

In the past twenty years, design/build has seen a resurgence both in total dollar amount contracted as well as percent of the total market share of construction. Figure 1 illustrates the growth of design/build over the past seven years in terms of new contracts issued annually. Figure 2 illustrates the percentage of design/build contracts as a part of total construction dollars spent. Data for Figures 1 and 2 comes from the annual "Top 400 Contractors" edition of *Engineering News Record* (*ENR*).

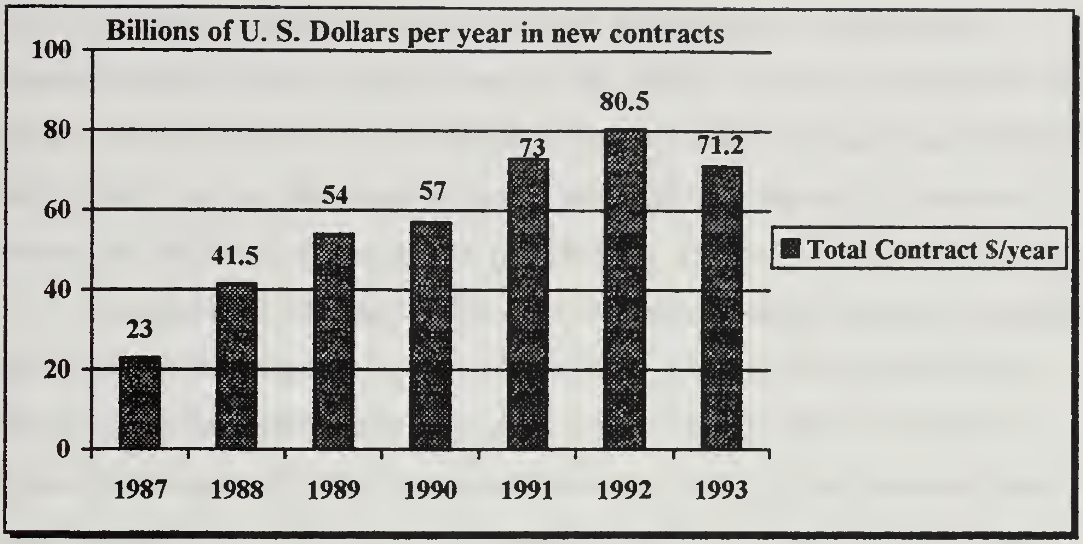

Figure 1. Histogram of total design/build dollars spent from 1987-1993 (*ENR*, 1994).

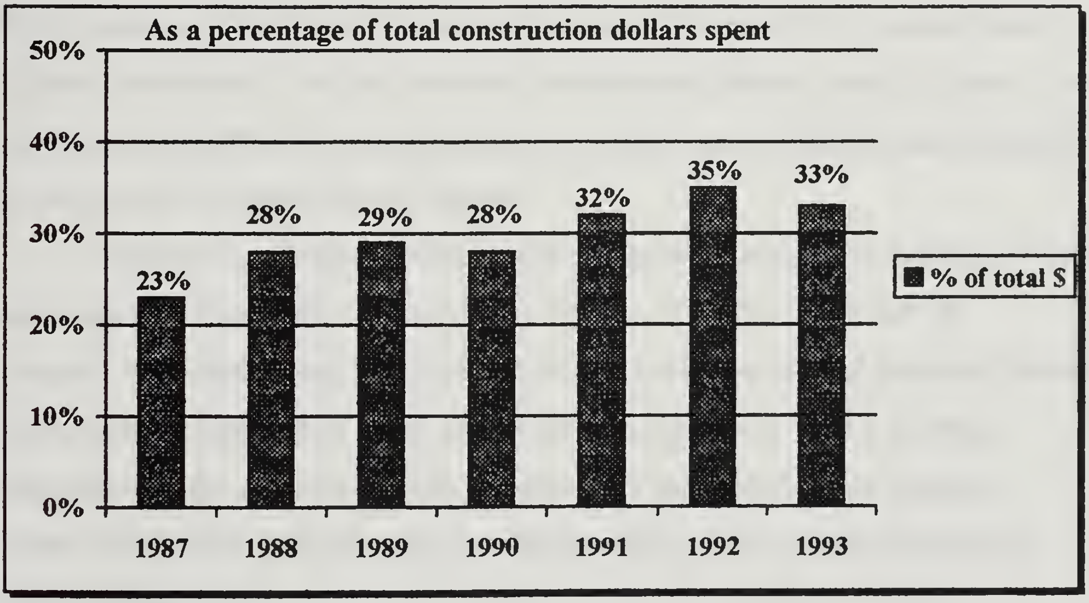

Figure 2. Histogram of percentages of design/build contracts from 1987-1993 in relation to total construction dollars (*ENR*, 1994).

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Mr. Preston Haskell, Chief Executive Officer of The Haskell Company, notes that the slight dip in 1993 design/build contracts reflects the general market trend, not a dip in design/build's popularity as a delivery system. Although the percentage data in Figure 2 does not support Mr. Haskell's claim, his perception of the industry trend is noteworthy. Mr. Haskell further says that the construction industry is experiencing a very positive trend in design/build projects, especially in contracts between ten and fifteen million dollars. (McManamy, 1994).

The resurgence of design/build can be attributed to several factors. Among the most notable is the American Institute of Architects' (AIA's) 1978 repeal of their ethical prohibition against design/build relationships (McKee, 1994). The repeal allowed the design/build delivery system to become a viable option for owners who were frustrated by escalating costs, increasingly complex contractual relationships, extended completion schedules and more complicated, technical design requirements.

Title 10 of the United States Code legislates the United States Armed Services. Steady revision to Section 2862, Title 10, U. S. Code, has allowed increased flexibility for all branches of the military to expand their use of design/build in selected areas of military construction. This evolution will be addressed in more detail in Chapter 4, but this increased flexibility in contracting for the Department of Defense has also added to the growth of design/build contracting.

Despite the widespread utilization of design/build contracting methods, limited documentation is available on the delivery system. In a 1993 article for *The Architect's Journal,* James Pain analyzed various studies conducted between 1944 and 1983 regarding weaknesses of the traditional delivery system. The following weaknesses of the traditional delivery system were identified by Pain; they are noteworthy because they represent specific strengths of the design/build delivery process (Pain, 1993):

- Ineffective integration between builder and designer.
- Poor relationships between members of the building process.

important factors the owner must consider when preparing the solicitation package and contract documents.

Preliminary Design: How Much is Enough? Too Much?

The solicitation for a design/build project must contain enough detail for the design/builder to understand the owner's requirements, yet allow enough flexibility for each design/builder to develop a creative and unique design solution. The balance between too much and not enough detail in the solicitation is a significant challenge when developing the solicitation package for design/build projects (Fiddler, 1995). Currently no standard exists that identifies an adequate level of detail for any given project.

The Health Care Financing Administration Headquarters Facility in Baltimore, Maryland has been categorized as a successful project completed by the General Services Administration (GSA) using design/build contracting methods. The request for proposal (RFP) for the project contained many details about the finished facility which constrained the design/builder's ability to present creative ideas for construction in the initial proposal. Creative ideas or the implementation of a new technology could only be introduced by the design/builder after the contract was awarded, and then the proposal would be considered utilizing a lengthy review procedure. The design/builder noted that the solicitation was too detailed in parts and that GSA could improve their design/build ventures if they stopped "spelling out every detail" in the RFP. The design/builder felt they could have reduced the overall project cost and provided more state-of-the-art systems if they had been given more freedom when completing their initial design of the facility (McKee, 1994).

The Federal Construction Council (FCC) reviewed 27 design/build projects for their report number 122, entitled, *Experiences of Federal Agencies with the Design-Build Approach to Construction.* The projects were for a variety of facilities, completed by various federal agencies, each using a unique solicitation package.

Figure 3 shows the distribution of the amount of preliminary design work completed for projects prior to award of the design/build contract. As noted in the FCC report,

> "The practices of the agencies with regard to the amount of design work performed prior to award of a design-build project was surprisingly diverse (Bebee, 1993)."

The FCC study concluded that the best results were obtained when projects were fifteen to thirty-five percent (15-35%) designed prior to award of a design/build contract. The worst results were obtained when the design was less than fifteen percent (15%) complete and "intermediate results" were observed if the design was over thirty-five percent (35%) complete. The FCC report did not provide an explanation for the survey results. The report indicated that the survey results are not conclusive. The quantity of design work which should be performed in advance of a design/build project is one of the three issues the report committee felt required further research (Bebee, 1993).

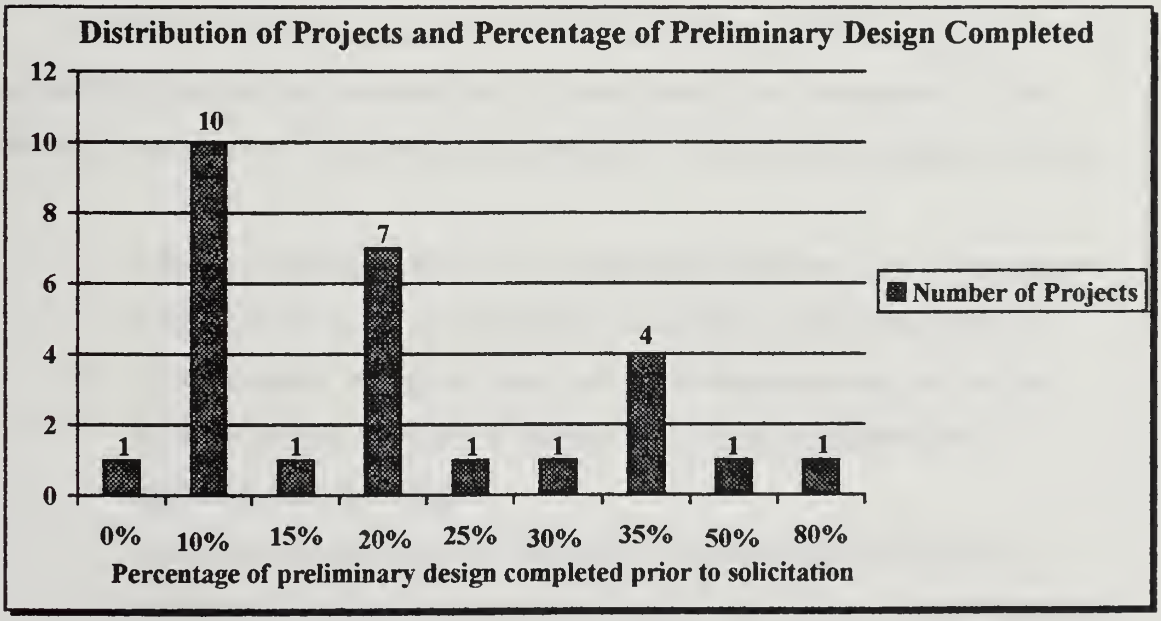

Figure 3. Percentage of preliminary design completed prior to design/build contract award (Bebee, 1993).

Mr. Nettleton has worked on design/build projects in which a portion of the design had been completed before the design/build contract was awarded and some where virtually no design work had been completed before the design/build contract. He notes that the projects where the design was partially complete were somewhat easier to work on, but he feels that may be because in those situations the owner had a better concept of what was desired as the final outcome. Neither option is the right solution, it depends on each individual project (Nettleton, 1994).

The amount of preliminary design that is completed prior to a design/build contract significantly influences the design/build project. Although a more complete design as part of the solicitation will ensure that the owner will receive a project consistent with the initial design work, an extensive partial design limits the number of creative solutions available to the design/builders. A partial design before the solicitation also increases the total project cost. The appropriate quantity of preliminary design is an unresolved issue with widely varying opinions.

Compensation for Unsuccessful Bidders

A 1970 document prepared by AIA recommends that all bidders who successfully complete the pre-qualification process should be compensated for their efforts in preparing their final design/build proposals. Three reasons cited by AIA are:

1. Limited competition will result if unsuccessful bidders are not compensated because fewer teams will compete for subsequent design/build projects.
2. "Cookie-cutter" design solutions will result because bidders will be less likely to prepare expensive proposals which illustrate creative new approaches for the design.
3. Least qualified personnel will ultimately prepare design solutions and documents with limited supervision because well paid personnel will pursue more lucrative projects with a higher potential return (Marshal, 1970).

Many owners have chosen not to compensate unsuccessful bidders. Perhaps the most widely discussed example of frustrated design/build teams occurred when the U. S. Corps of Engineers requested proposals for the Sparkman Center in Alabama. In addition to other documents, the solicitation requirements included extensive design efforts. Sixteen teams submitted proposals in accordance with the solicitation, but only one team was awarded the contract. The remaining fifteen bidders received no compensation for their expensive submittals (Nesmith, 1994).

The GSA encountered a similar situation when they requested proposals for a $100-million Internal Revenue Service facility in Detroit, Michigan. Each proposal cost the design/build teams between $250,000 and $500,000. Eleven teams submitted proposals, one was awarded the contract and the other ten received no compensation for their submittals (Nesmith, 1994). After lengthy discussions, the City of Chicago agreed to compensate unsuccessful bidders who submitted proposals for the Chicago Public Library. The compensation, however, was far less than the $500,000 design/build teams spent in preparing their proposals in accordance with the solicitation requirements (Solfisberg, 1991).

In design/bid/build procurements, unsuccessful bidders are rarely compensated for their efforts to prepare bids. In design/build, however, the cost to prepare the proposal is significantly higher because considerable design effort is necessary before an estimate for the construction costs can be developed. When compensation is offered for unsuccessful bidders it usually does not fully compensate the design/build teams for their efforts (Nesmith, 1994). Design/builders do not necessarily expect to be fully compensated for their initial efforts, but they view the payment as a sign of good faith by the owner. Compensation for the unsuccessful bidders also shows that the owner recognizes that design/build proposals are more complex and expensive to prepare than traditional bids (Nettleton, 1994).

Public and private owners are not inclined to compensate unsuccessful bidders because they do not feel they receive anything of value from the unsuccessful

proposals (Fiddler, 1995; Verdalli, 1995 & Baker, 1995). The solution lies in simplified proposal requirements. By limiting the time and effort required of the bidders, less expensive proposals will be submitted, and compensation for unsuccessful bidders will become less important. However, evaluating the less complicated proposals increases the burden on the owner because less detailed information will be provided for review.

The owner must determine exactly what is required in the submittal to accurately evaluate the proposals. If the proposal requirements can be streamlined, the design/build teams will have less invested in their proposals and will be less concerned about compensation for unsuccessful bids. If the owner requires extensive design effort and a detailed cost estimate, however, compensating the unsuccessful bidders should be considered.

Pre-qualifying Prospective Proposers

Limiting the number of potential bidders by pre-qualifying the proposers limits competition, but it can ensure that owners only review proposals from design/build teams they have already determined to be qualified to complete the desired project. The National Society of Professional Engineers (NSPE) advocates a procedure called "short-listing" which they define as follows:

> "Short-listing, whereby first, an unlimited number of firms may submit a statement of qualifications; then the owner will select a limited number of firms that would then be eligible to submit detailed proposals," (Worischeck, 1994).

Worischeck suggests that the pre-qualification system reduces the number of teams who will needlessly prepare the expensive proposals typical of design/build competitions. This logic also supports NSPE's recommendation to compensate unsuccessful bidders because owners will be able to control how many teams can submit proposals and therefore budget appropriate compensation.

Kevin J. Potter is a 1994 Masters Graduate from the Pennsylvania State University's Architectural Engineering program. Potter completed a thesis which presented a design/build pre-qualification system. Potter promotes pre-qualifying design/build teams and lists criterion which the teams would be evaluated against to become pre-qualified. Most of the standards are experience and organizationally based (Potter, 1994). His process is well organized but is untested. Owners would be well served by reviewing the criterion presented by Potter when establishing a pre-qualification system.

Nettleton and Dussinger are both design/build team leaders and both are advocates of pre-qualification systems which limit the number of competitors eligible to submit proposals on any given project. Nettleton observed that a pre-qualification system ensures that all competitors have been screened and that all of the proposals submitted will be carefully reviewed by the owner before an award is made. If too many proposals are received, it becomes increasingly difficult to equitably evaluate each one (Nettleton, 1994). Dussinger is against awards based strictly on the lowest cost proposal. He is most comfortable when the competition is limited to three pre-qualified teams and the contract is awarded on the entire presentation, not just the lowest final cost (Dussinger, 1995).

Pre-qualifying proposers limits competition, but it can ensure that all proposals are evaluated completely and equitably. Short listing requires an extra step in the procurement process and may lengthen the overall project duration. The risk of pre-qualifying bidders is that a great team may be precluded from the competition due to a lack of experience or qualifications. However, pre-qualifying teams ensures that owners only evaluate proven competitors, and they are more likely to be satisfied with the finished product.

Guaranteed Maximum Price (GMP) and Effects on Creativity

A common element required in design/build proposals is a guaranteed maximum price (GMP). The exact contract arrangements vary, but the GMP is an

assurance by the bidder that without owner generated changes or unforeseen site conditions, the total construction cost will not exceed the GMP. If the construction is completed for less than the GMP, the remaining funds are often divided between the owner and the design/builder based on an incentive clause specified in the contract. The owner must ensure that the contract allows for a review of expenses on the project otherwise the GMP may become a guaranteed maximum *profit* for the design/builder. A GMP is less risky for the design/builder than a firm-fixed-price, but still requires that the design be substantially complete prior to submitting a proposal. If a two-step solicitation is utilized, the GMP should be part of the second submission, and may be weighted heavily in the overall evaluation.

When a GMP is required before the contract is awarded, design/build teams may be reluctant to propose creative approaches due to the uncertainty of pricing such ideas (Marshal, 1970). Design professionals involved in design/build projects are held strictly to their initial concepts. Consequently, designers tend to be more conservative when a GMP is included as part of the proposal, because accurately pricing the concept is critical to the success of the project (Cramer, 1995). The Chicago Public Library is an example of how a GMP influences the solicitation process. Design/build teams were required to provide a GMP, which they felt severely limited their creativity, because a price had to be generated based on the conceptual design (Solfisberg, 1991).

Owners are at a disadvantage when preparing their initial cost estimates because they can not be certain how their requirements will be incorporated into the final design. Consequently, securing financing can be complicated for owners because lending institutions usually must be advised of the total project cost. Owners are therefore, inclined to require a GMP to ensure that they can secure adequate construction loans. The GMP also allows owners to conduct an economic evaluation of the proposals as part of the selection process.

Developing a GMP increases the cost of bid preparation for design/build teams because more time is spent developing the design and estimating costs precisely.

Despite the impacts on designer creativity, and added expense for bidders, a GMP as part of the solicitation requirement provides the owner with valuable information when evaluating proposals. A GMP is less precise than a firm-fixed-price, but can be provided with less risk to the design/builder. A GMP has some drawbacks, but taken collectively the advantages for the owner outweigh the disadvantages to the bidders.

Performance versus Prescriptive Specifications

Performance specifications depict the required performance characteristics for the element described. Prescriptive specifications (also called design specifications, materials and methods, or detailed specifications) describe precisely what materials are to be utilized and exactly how the work is to be accomplished (Sweet, 1994). Performance specifications allow creative approaches, provided the finished product satisfies the specified requirements. The Design/build process is based on the principle of performance specifications. Prescriptive specifications may still be necessary in design/build projects, particularly for maintenance planning or other corporate wide standardization programs, however, a major reason for utilizing the design/build process is to encourage designer creativity.

Military construction contracts have included a greater number of performance specifications in all types of contracts since January 1984, when the Secretary of Defense established them as the, “preferred way to state acquisition requirements.” Developing performance specifications requires that the owner conduct a thorough evaluation of the required outcomes. They may be more difficult to develop initially, but they will result in:

- Lower acquisition costs.
- Improved utilization of technological advancements.
- Reduced lead time due to commercial availability.
- Risk shifting to the design/builder.

Performance specifications are used throughout the Navy's design/build contracts (Spaulding, 1995).

Owners must balance the use of performance and prescriptive specifications. Unless required for specific reasons, performance specifications should dominate the design/build process. Performance specifications maximize several of the positive aspects of the design/build process, most importantly: creative design solutions, risk shifting to the design/builder and taking rapid advantage of technological improvements.

Owner Education in the Design/Build Process

Most owners are knowledgeable about their business or production process but they may not possess a thorough understanding of the construction industry (Dussinger, 1995). Owners are becoming more familiar with the construction industry; but most build only once every fifteen years (Narula, 1994). The owner's lack of construction expertise combined with the re-emergence of the design/build delivery system has the potential to create unsatisfactory results for owners. However, design/builders feel strongly that it is their responsibility to ensure that the owners are satisfied with the finished product and are educated throughout the construction process (Dussinger, 1995; Narula, 1994 & Nettleton, 1994). The positive attitude of construction professionals is an encouraging element of the design/build process. The construction professionals involved with design/build are concerned about the long term outlook of the construction industry and are genuinely concerned with customer satisfaction.

Summary

The issues addressed in this chapter must be considered before a design/build contract is prepared. The effort expended in the initial planning is critical for a successful design/build project. Each decision must be based on careful examination of the associated risk for each of the issues addressed. The design/build delivery system is very flexible. If owners evaluate their options, they can effectively prepare the contract to ensure that the overall project organization protects their interests.

Chapter 3.

Post-Award Issues

Introduction

In design/build contracting, a single agreement is executed for the complete project. Once the contract is awarded, the successful team completes the facility design and begins construction. This chapter discusses the issues which develop or must be considered after the design/builder has been awarded the contract. Many of the issues presented are considered strengths of the design/build process but most issues have some inherent risk. An understanding of the issues and an appreciation of the associated risk will facilitate improved utilization of the design/build delivery system. The following specific issues will be addressed in this chapter:

- *Owner's ability to Make Changes Once Award is Made*
- *Value Engineering Throughout Entire Process*
- *Flexibility of Information Transfer Between Designer and Constructor*
- *Potential for Compromised Integrity by Design Professionals*
- *Lack of Direct Owner to Designer Interface*
- *Design Professionals are Responsible for Job Site Safety*
- *Increased Pressure on Owners to Complete Reviews in a Timely Manner*
- *Simplified Level of Detail in Final Construction Documents*
- *Measurement of Design Completion Percentage for Progress Payments*
- *Risk Acceptance by the Design/Build Team*
- *Contractor Usually Controls the Overall Process*
- *Fewer Change Orders*
- *Streamlined contract administration*

Issues

Owner's ability to Make Changes Once Award is Made

A common perception of design/build procurements is that the owner loses control of the project once the contract is awarded. As long as the design/builder complies with the quality standards, the owner has virtually no authority to make changes. If changes are required, they are expensive and difficult to make. Mulvihill writes about this loss of control and inability to make changes as a concern for owners and a weakness of the design/build process (Mulvihill, 1994). As the following illustrates, research on actual projects does not support Mulvihill's conclusion.

Design/build projects are frequently organized per a tightly controlled schedule. Owner requested modifications may impact the schedule and affect other building systems which results in high costs for changes. For example, a change in the size of the air conditioning unit may require additional structural support and increased electrical service. Therefore, the total cost of the change is substantially more than the difference in cost between the air conditioning units. Field inquiries illustrate that owners are satisfied with their ability to make changes, provided they are made early in the process, and with a thorough understanding of the costs.

Dan Verdelli is the owner of Verdelli Farms, Inc. He thoroughly understands the requirements for a food processing facility, but is not experienced in construction contracting methods. Verdelli recently had a 75,000 square foot, food processing plant constructed utilizing the design/build delivery system. Intrigued by the simplicity of the design/build process, Verdelli was ultimately very satisfied with his finished facility. As the design was developed, frequent meetings were held with the contracting team and Verdelli had constant input on building components and system selection. Because the planning was done as part of a team organization, minimal changes were required, but those changes proposed were discussed and the final decision was made with a thorough understanding of the impacts caused by the change. Verdelli noted that his ability to make changes throughout the entire project,

fully aware of the associated impacts, was a significant strength of the design/build process (Verdelli, 1995).

The Hershey Corporation recently completed a $100-million processing facility. Hershey wanted to be closely involved with all phases of the project and wanted to take advantage of the latest manufacturing process innovations. Design/build allowed Hershey interaction with the contracting team throughout the design and construction of the facility. Changes were made during all phases of the project without significant cost impacts. The facility was completed in twenty three months and was considered successful by Hershey because of their ability to make adjustments during the project (McKee, 1994).

Changes in construction projects are expensive regardless of the delivery system. The later changes are made, the more expensive they will be. Changes frequently create a ripple effect throughout the project, which may result in increased costs to other building systems. Changes often cause expensive delays, especially if materials have to be re-ordered or if re-work is required to incorporate the change. Owners frequently fail to recognize the true cost of change and the associated impacts. Design/build projects may be more sensitive to changes due to their closely controlled schedules, resulting in higher costs for changes. Pro-active owners who are part of an effective design/build team are satisfied with their ability to make changes and understand the associated costs.

Value Engineering Throughout Entire Process

The ability to make changes is not exclusively an owner concern. A major advantage of many design/build acquisitions is the ability to "value engineer" throughout the project. Value engineering is the process of introducing changes during construction which are intended to lower the project cost or improve the facility life cycle costs. McKee advocates value engineering in design/build projects; he notes that designers can "exploit" the intelligence of constructors at every step in the process (McKee, 1994). Designers may consider some value engineering

initiatives as cost cutting proposals designed to increase the design/builder's profit margin (Stone, 1995).

Value engineering proposals can be risky for owners. Cost savings may be realized, but unanticipated drawbacks may result. Contractual arrangements may be implemented to protect the owner, but the arrangement may negatively impact the designer's and/or builder's creativity. The owner's risk aversion and utilization of a third party consultant (discussed in Chapter 2) should dictate how easily value engineering proposals can be adopted for design/build projects.

Not all contracts allow for easy changes by either party once the design has been reviewed. U. S. Navy design/build contracts require an initial design approval before construction is authorized. Changes made to the approved design go through a detailed review and approval process. Cost savings which result from the approved value engineering proposal are divided between the design/builder and the government (MIL-HBK-1006/5, 1994). This arrangement may inhibit cost saving initiatives once the design is approved, but it protects the owner from potential cost cutting initiatives (submitted as value engineering proposals) which may diminish the overall quality of the facility or ultimately result in increase life cycle costs.

Flexibility of Information Transfer Between Designer and Constructor

Effective communication is an essential component of any successful endeavor. A streamlined organization which facilitates the rapid transfer of information is a critical element for effective communications. Design/build organizations should be less complicated than traditional contracting organizations because the designer and builder are teamed together. This team relationship enhances the ability to develop quick resolutions to field problems because both the designer and builder are searching for the solution to their mutual problem. This organization is contrasted with the design/bid/build relationships where information is frequently transferred via the owner, and many simple field inquiries or revisions require owner review and/or approval.

Ram Narula is a Project Engineering Manager for Bechtel Power Corporation. Most of the projects he works on are both designed and built by Bechtel Power Corporation. Narula notes that a major advantage of design/build contracting is the "increased sense of urgency" characteristic of design/build organizations. Communications are simplified because the builder who experiences a problem in the field can quickly contact the designer requesting a solution. Because the designer and builder are working together, the team will be more likely to develop an immediate solution regardless of the reason for the problem in the field. In traditional contracting relationships, the designer may be more likely to asses the field problem for liability concerns, why the problem occurred, who is to blame, who will pay for the additional work if necessary, etc. before a solution is developed. The designer's apprehension frequently delays the solution and ultimately adds to the overall project cost (Narula, 1994).

Mulvihill states that builders have more at stake in construction and usually control the design/build process. Therefore, designers are frequently hired as subcontractors to the builder (Mulvihill, 1994). This contract arrangement places the designer in a subordinate position. Designers are required to provide immediate responses to field inquiries. The pressure placed on designers by constructors ensures that quick replies are provided, but it may place designers in the difficult position of conducting hasty reviews to avoid delays in the construction. The next issue evaluates the possible impact of this builder-imposed pressure on the design professional.

Potential for Compromised Integrity by Design Professionals

In the design/bid/build delivery system, the designer is contracted by the owner and is usually the owner's agent. The designer ensures that the construction is completed in accordance with the design documents. Although concerned with the overall construction cost, the price is subordinate to the design intent, so any efforts made to reduce cost by the constructor at the expense of quality or design integrity are challenged by the designer. As the owner's agent, the designer closely reviews shop

drawings and submittals and is empowered to confront the builder in the field. The designer is also obliged to notify the owner of any revisions or discrepancies on the project. This issue discusses the design professionals review responsibilities; the next issue will address the design professionals communication with the owner.

In design/build contracting, the role of the designer is not always clear. Depending on the contractual relationships, the design firm may be concerned about the financial outcome of the construction because they are in a position to make or lose money depending on the construction's profitability. This apparent conflict for designers may make it difficult for them to balance between profits and their obligation to the owner and potentially even sacrifice public safety (Natkin, 1994).

Individual designers indicate that they are generally not concerned about the financial conflict of interest, but they are frequently rushed to complete every aspect of the design. The builder is normally in the dominant contractual position and they can exert pressure on the designer to quickly complete construction drawings, shop drawing reviews and/or subcontractor submittal reviews. This pressure to work hastily may cause the designer to overlook certain elements of the design or review process. If not identified, substitutions from the original design may go unnoticed. Even when noted as a substitution, the change may not be reviewed completely or receive the full attention it deserves from the design professional. These changes from the original design concept may create future problems or may otherwise degrade the long term facility performance. Individual designers are concerned that the pressure to work very quickly may result in mistakes on their part, and these mistakes could have disastrous consequences (Cramer, 1995).

Owners must be aware of the contractual arrangement between the designer and the builder. Although owners do not have much influence regarding subordinate contracts, they can take action to protect their interests if they are concerned about the contractual relationships of the design/build team. For example, owners can limit potential proposers to design/build teams with design professionals as the prime contractor, or otherwise limit competition to only selected contractual arrangements.

Limiting competition may preclude the owner from taking advantage of other features of the design/build delivery system. Another alternative for owners is to hire a third party designer as a consultant, or to employ an independent inspector. Regardless of why the designer overlooks a revision or substitution, the owner can mitigate the risk of such changes by taking appropriate actions to monitor the construction.

Lack of Direct Owner to Designer Interface

Designer's viewpoint. As previously noted, designers in traditional contracting organizations are accustomed to a close relationship with the owner. Sweet defines this as a fiduciary relationship, and states that the core of a fiduciary relationship is "trust and confidence" (Sweet, 1994). Designers in a design/build contract are not obligated by this fiduciary relationship with the owner, in fact they may not interact frequently at all with the owner. Meetings with the owner may be held with both the designer and the builder in attendance, and the designer's field reports are typically filed with the constructor, not the owner. The design professional community is concerned by this lack of direct owner and designer interface. Individual designers have also expressed concern that deficiencies reported to the builder may go unheeded (Cramer, 1995).

The National Society of Professional Engineers (NSPE) states in their recent discussion paper that they are "neither an advocate nor opponent of the design-build project delivery system," (Worischeck, 1994). The paper provides a concise review of the delivery system, identifies the perceived strengths and weaknesses of the process and lists fifteen "key considerations" which should be reviewed before a design/build contract is created. Two of the "considerations" are relevant to the issues of communication between the designer and owner, and the designer's authority over design related matters. Those two considerations are that:

- "the designer retains authority to make design decisions;
- the designer retains a direct line of communications with the owner."

The NSPE paper further dedicates a section to owner-designer-constructor communications. The overriding concern projected by NSPE is that builders may dominate the owner interface because they dominate the overall construction process due to the higher relative value of construction-related costs. Regardless of the design/build team organization, NSPE advocates direct access to the owner for the design professional in all matters concerning design (Worischeck, 1994).

The American Institute of Architects (AIA) has also expressed concern about the lack of direct owner and designer interface. The AIA advised the federal government that design/build acquisitions should ensure that contracts identify clear lines of communication between the owner and the designer (*Architectural Record*, 1993). It is reasonable to assume that AIA's advice to federal owners also applies to private design/build contracts.

Builder's viewpoint. Builders feel that designers have an "arrogant attitude" regarding their "special relationship" with owners (Nettleton, 1994). Narula and Dussinger both feel that a relationship of trust and confidence is developed between the contracting team and the owner in design/build projects. Both seemed offended by the implication that only designers were entitled to close, teamwork relationships with owners (Narula, 1994 & Dussinger, 1995). None of the builders interviewed felt that direct owner to designer interface was necessary, nor that projects suffered from this lack of direct interface.

Owner viewpoint. Mr. Baker is a well informed owner who is aware of the advantages and disadvantages of design/build contracting. He is not concerned by his lack of direct interface with the designer because the design/builder is accountable for the total project. Baker is confident that design/build organizations have been fair with him in the past and communications have always been open (Baker, 1995). Not all owners are as well educated as Baker, nor as confident in the construction process, but all owners should be aware of the potential pitfalls created by a lack of direct communication with the designer.

Design Professionals are Responsible for Job Site Safety

Another issue which contrasts with the designer's traditional role in construction concerns job site safety. Although everyone on a construction site must be concerned about safety, designers have traditionally been exempt from liability when safety violations are a result of the builder's construction practices (*Waggoner, et. al. versus W. & W. Steel Company*, Supreme Court of Oklahoma, 1982 (657 P.2d 147)). In design/build contracting, the designer is part of the construction team and therefore must be specifically concerned with job site safety (Natkin, 1994). Proper work sequencing can enhance the safety of construction operations. The designer can influence work sequencing through effective planning and coordination with the builder during the design process. This coordination is especially easy when design/build contracting methods are employed.

Designers may not be accustomed to this increased awareness regarding safety concerns. Designers can reduce their exposure to liability by training their designers in the basics of job site safety and interacting with the builders to coordinate design parameters and proper sequencing techniques. The net result of the designer's awareness should be improved construction safety which is a positive result for the designer, builder, owner and most importantly for the construction workers.

Increased Pressure on Owners to Complete Reviews in a Timely Manner

Mr. Narula addressed the increased sense of urgency for the design/build team, and this sensitivity to timeliness must also be realized by the owner. Many design/build contracts provide owners with the opportunity to review and approve the final design or to review the design at various phases. The owner must complete the review in a timely manner to avoid schedule impacts and costly delays.

McKee addressed owner reviews in a recent article in *Architecture*. The article focused on public projects and stressed the importance of timely government reviews (McKee, 1994). If the reviews are not completed in a timely manner, the owner is

subject to very expensive claims. Many design/build contracts utilize "fast-track" scheduling (to be discussed in detail later), so the delay claims may include expenses for idle equipment and other field overhead costs which accrue while the builder waits for the owner's approval of the design submittal.

John Fiddler is a Project Manager with the Northern Division (NORTHDIV) of the Naval Facilities Engineering Command (NAVFAC), and he is specifically in charge of design/build contracts for NORTHDIV. Mr. Fiddler noted that the design review process is a concern with NAVFAC projects because the review period is only thirty days, and requires many steps (MIL-HBK-1006/5, 1994). NAVFAC has had good success completing the design reviews within the specified time period, but meeting the deadlines has frequently required considerable attention by higher levels of management. Streamlining the review process by removing or simplifying steps is something NAVFAC is considering (Fiddler, 1995).

Owner review is a valuable element of a design/build contract which should be included wherever possible. Owners must be aware, however, of the potential impacts of taking too long to review designs or other submittals. Owners should ensure that the contract language is clear regarding the timeliness of review, and they should comply with the contract requirements. A proper design review by the owner will also resolve uncertainty about the final design concept. Regardless of who ultimately pays for specific changes, a design review may allow the owner to make changes before construction gets too far along, which will result in a reduced cost for revisions.

Simplified Level of Detail in Final Construction Documents

Many of the detailed drawings used on construction projects are prepared by the specialists who will actually complete that item of work. The specialist prepares shop drawings which are used for fabrication and installation or erection of the actual components depicted. Common examples of construction elements which require detailed shop drawings are fire protection systems, curtain wall assemblies, glass and glazing details, structural steel fabrication and erection, pre-cast concrete components

and environmental control systems. Preparing shop drawings is an expensive yet necessary endeavor to ensure that all of the components fit together properly, support the necessary loads, etc.

A design/bid/build project generally provides very detailed contract documents which include complete system designs. The design/bid/build contract documents may also require that various shop drawings be prepared by the specialist who will actually perform the work on the given systems. This duplication of design effort inflates the overall project cost and results in very little added value. A major advantage of design/build contracting is that this duplication of costly engineering time can be largely eliminated. The detailed drawings necessary for fabrication and installation are completed only once by the specialists in close coordination with the design engineer. This economy of effort results in cost savings for design/build projects and improves the efficiency of the construction process.

Stubbins Associates created a design/build team called Hyman/Stubbins, Inc. Stubbins Associates was concerned that their architects and engineers were having problems limiting their design efforts to the minimal required information because the designers were accustomed to preparing the detailed drawings which accompany traditional contract documents. To reinforce the necessary shift in ideology, Stubbins Associates developed the term “working documents” to replace the term ”contract documents” for the designers. The intent of the new term was to emphasize that design/build construction drawings are fundamentally different from traditional construction drawings. “Working documents” are less detailed, especially where the construction specialists will have to prepare subsequent shop drawings to provide the necessary detail to install their specific components (*Architectural Record*, 1993).

Mr. Nettleton observed that final construction drawings can be less detailed where shop drawings and catalogue submittals complete the design. This requires that architects and engineers release some control of the final design details. The team concept of design/build projects ensures that the designer is involved throughout the process, but it eliminates much of the redundant effort typical in traditional contracting

methods (Nettleton, 1994). The simplified level of detail necessary in the final design/build construction drawings is a strength of the design/build delivery system which improves the efficiency and economy of the construction process.

Measurement of Design Completion Percentage for Progress Payments

Progress payments are a normal part of construction projects. Payment for work in place on the construction site is relatively easy to determine by deriving the percentage complete of a specific task and paying accordingly. Partial payments for designs are more difficult to calculate than payments for construction work in place. Determining the percentage complete for design documents is especially difficult for design/build projects because the final drawings are usually less detailed than traditional designs. Fiddler commented that progress payments for designs with NAVFAC projects is a concern for contract administrators who may be unaccustomed to reviewing design documents for payment. Coordination with higher level management can normally resolve the issue of determining the appropriate progress payment for design work (Fiddler, 1995).

A possible resolution to the difficulty in determining the amount of progress payments for design work is to establish predetermined milestones. When the design/build team completes a specific portion of the design, they are paid a fixed amount. Using milestone payments mitigates the risk of overpayment for partial designs and avoids conflicts in calculating the design's completion percentage.

Risk Acceptance by the Design/Build Team

The most widely acknowledged advantage of the design/build contracting method is the single source of responsibility for the owner. The single source is responsible for the project outcome and accepts the risk of both the design and construction, but most importantly the risk of coordinating the two efforts. The owner is no longer in the middle of disputes which may arise between the designer and builder; the coordination of these efforts is the sole responsibility of the design/build

team leader. This cooperative effort results in improved efficiency which should decrease the project cost, reduce the project duration and facilitate harmony between design and construction, but it also may obscure the chain of responsibility for cost overruns, delays, building system and/or structural failures (Cushman, 1994). The obscured chain of responsibility mentioned by Cushman, however, pertains to the design/build team; the owner is still relying on the sole source of responsibility to complete the project.

Mr. Baker notes that the owner sheds a considerable amount of risk when design/build procedures are employed. The risk shifting allows Baker to observe more of the construction without becoming embroiled in disputes which are outside his area of expertise. In his experience, the design/build team leader has accepted the risk and responsibility, and has been in control of the process. Baker considers the risk shifting away from the owner to be an advantage of design/build contracting (Baker, 1995).

The Foley Square Courthouse is a design/build contract administered by the GSA in New York City. GSA effectively transferred the risk to the design/build team by establishing severe penalties for missed deadlines, etc. (McKee, 1994). In this case the contract reinforced the risk shifting by including substantial disincentives for contract non-compliance, but the result was still a shedding of owner risk.

Design/builders accept the additional risk as part of the design/build process. Profit margins are usually higher on design/build projects than on traditional contracts because of the added risk accepted by the team leader. As noted by Horton, the design/build contract should be carefully prepared to, "insure that risks and responsibilities are fairly allocated among parties," (Horton, 1994).

Contractor Usually Controls the Overall Process

The most common design/build arrangement is with the designer as a consultant for a builder who then becomes the designer's client (*Architectural Record*, 1993). The builder, therefore, usually dominates the process and is team leader. The

team leader controls the entire construction process. Most notably, the team leader is responsible for the schedule and budget control.

Budget control. Budget control is the process of managing the project financially to ensure that adequate monetary resources are available when they are required. The team leader submits the pay requests to the owner and distributes the payments to the subcontractors. General contractors who undertake design/build projects are accustomed to this role and have very little problem controlling the budget.

Schedule control. Schedule control is a somewhat more complicated than budget control. An advantage of the design/build delivery system is the ability to utilize "fast-track scheduling." Fast-tracking is a process where construction activities progress just behind the design. For example, the foundation work may be underway in the field while the designer is completing the structural steel details. Coordinating these closely scheduled activities can be difficult, but the process can reduce the project duration.

Cramer observes that, because of the normal design sequence, fast-tracking puts a significant burden on the designer. Designers usually design a building from the roof down, transmitting the loads to successively lower floors and ultimately to the foundation. Unfortunately for designers, buildings are constructed from the foundation up. Once the contract is awarded, the builder wants to start work on the foundation and other civil work, but the designer may not have completed that portion of the design so quickly. The builder pressures the designer to finish the foundation drawings quickly, even if it is somewhat over-designed, so the construction work can begin (Cramer, 1995).

Mr. Dussinger observes that he can effectively control the schedule on design/build projects. With his team development concept, all parties can see the schedule impacts, and that understanding enhances performance. Most of the projects Dussinger has worked on have been fast-tracked and he has never encountered significant schedule delays. He feels that his ability to complete the projects quickly by

controlling the schedule and maximizing fast-track techniques improves the design/build delivery system's acceptance in the construction industry. Rapid completion also satisfies the customer's desires and allows Dussinger's team to move on to compete for other projects (Dussinger, 1995).

The abbreviated schedules made possible by fast-tracking techniques is a positive attribute of design/build projects. Fast-tracking can be risky if problems develop because all of the construction activities are very closely coordinated. A delayed activity may affect other work and cause expensive delays. Not all design/build projects are fast-tracked. Owners who want to review each step of the design may not benefit from fast-tracking because their ability to make changes may be constrained and revisions may be quite expensive.

Schedule studies. As mentioned, the builder usually controls the overall project in design/build acquisitions. The builder controls the schedule with or without fast-tracking. Another advantage of the design/build delivery system is the limited schedule growth. Very few quantitative studies have been completed to compare design/build contracting with other delivery systems. Two studies which have evaluated design/build projects were completed by the Construction Industry Institute (CII) and a U. S. Navy, Civil Engineer Corps Officer while he was a student at Purdue University.

CII completed a study in 1993 entitled, *Early Warning Signs of Project Changes.* The study evaluated multiple projects at a macro level, and attempted to identify early warning signs of project cost and schedule growth. Data were collected from 106 projects. The study was not specifically conducted to evaluate design/build or any other delivery system, but the data set contained projects which utilized various delivery systems and various award formats. Figure 4 shows a comparison of schedule growth for fixed price contracts utilizing different delivery methods. Schedule growth was defined by the equation:

$$\text{Schedule growth} = (\text{Schedule increase}/\text{Original duration})$$

"CM" represents construction management which is a delivery system that utilizes a construction management firm to coordinate the work for the owner. The CII study notes that CM is usually a four party arrangement involving the owner, designer, contractor and construction manager. "D/B/B" represents the design/bid/build or traditional delivery system already defined and "D/B" is the design/build delivery system (Zeitoun, 1993).

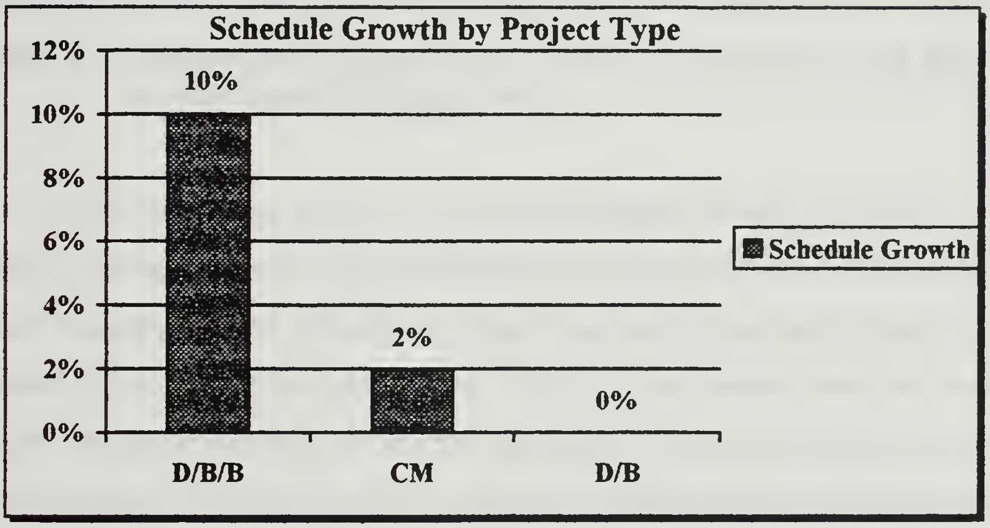

Figure 4. Schedule growth trends for fixed price contracts using different delivery systems (Zeitoun, 1993).

Figure 5 illustrates schedule growth for the three types of delivery systems when cost reimbursable contracts were used. Cost reimbursable contracts are more likely to be used when the project scope is not well defined. With a cost reimbursable contract the owner can develop the scope as the engineering and construction progresses. The CII study suggests that design/build contracts compare favorably to other delivery systems regarding schedule growth.

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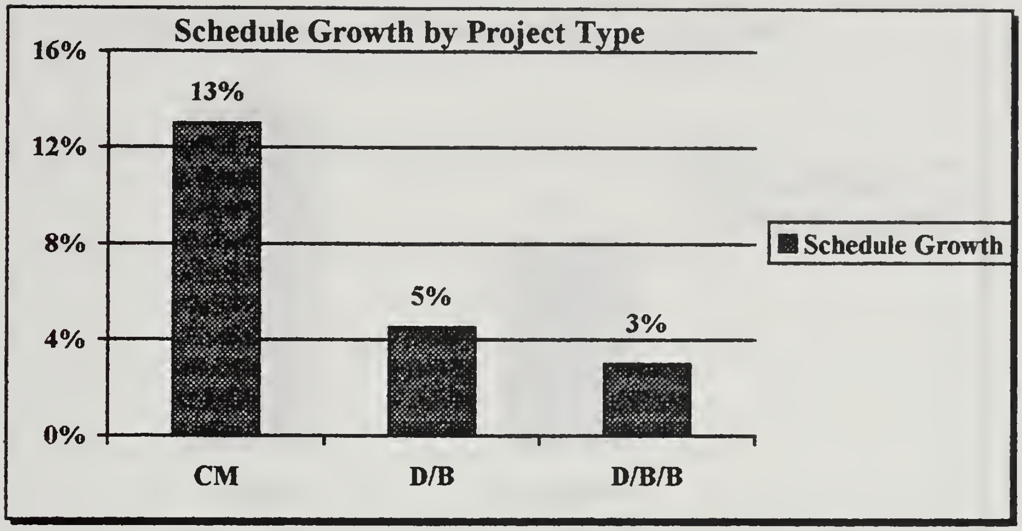

Figure 5. Schedule growth trends for cost reimbursable contracts using different delivery systems (Zeitoun, 1993).

John W. Mouritsen is a U. S. Navy, Civil Engineer Corps Officer, who completed a Masters Degree in Construction Engineering and Management from Purdue University in 1993. Mouritsen's thesis compared design/build projects to traditional delivery system projects within NAVFAC. One unique aspect of the study is that the projects evaluated were all child care centers, and the contracts were all awarded in Fiscal Year 1990 (FY90). Mouritsen evaluated eleven child care centers, five of which were constructed using design/bid/build contracting methods; the other six were constructed utilizing design/build contracting methods. Mouritsen compared overall project duration and as shown in Figure 6, the design/build projects were completed nearly nine-and-one-half-months (the average was 9.4 months) faster than the traditional projects (Mouritsen, 1993). Mouritsen compared overall project duration, but the results support the concept that design/builders can control the schedule and reduce overall delivery time when compared with design/bid/build projects and their inherently more complex contractual relationships.

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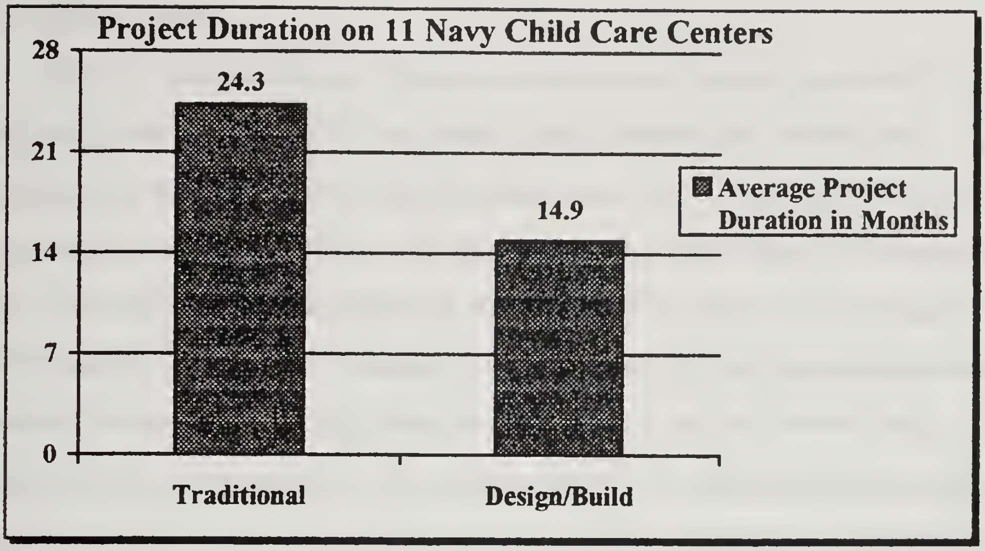

Figure 6. Average project duration for 11 Child Care Centers constructed by the U. S. Navy during Fiscal Year 1990 (Mouritsen, 1993).

Mr. Verdelli was satisfied with the schedule control demonstrated by the design/builder when his food processing plant was constructed. Time was not wasted and there were no apparent slowdowns or periods when the project site was not fully manned by craftsmen. Verdelli considers the improved schedule control on design/build projects a "big plus for owners" (Verdelli, 1995).

Schedule control is an important element of managing construction projects. Effectively coordinating design and construction efforts on design/build projects can result in direct time savings as demonstrated by Mouritsen's study or minimize schedule growth as illustrated by the CII study. Owners appreciate the advantages of a shorter schedule. Design/builders also benefit from a shorter schedule if they can complete more projects in less time while avoiding costly delays. The builders who primarily control the design/build process are well equipped to handle the responsibility of controlling the schedule and budget. While designers may feel pressured to meet deadlines or specific milestone dates, their ability to satisfy the requirements will continue to enhance the effectiveness of the design/build delivery system.

Fewer Change Orders

As previously mentioned, changes on construction projects are costly. Design/build projects are said to have fewer change orders than conventional contracting procedures. Clearly design/build projects will not experience design related changes because problems with the interface between design and construction are the responsibility of the design/build team. Certain revisions to the design are made throughout construction because no design is perfect, but these adjustments do not impact the owner. The design/builder is usually not entitled to additional compensation for design related changes because the coordination of design and construction efforts is the design/builder's responsibility. Change orders will develop on construction projects, yet the commonly published opinion is that design/build projects have a lower overall change order rate than traditional contracts.

Subjective study. The previously referenced FCC study asked public owners to compare the number of design/build project change orders with the number of change orders *expected* on similar traditional projects. The public owners gave the comparison a score from zero to ten with zero representing, "much worse performance" and ten representing, "much better performance" by design/build projects compared to similar traditional projects. The average score on change orders from all 27 projects evaluated was 9.00 (Bebee, 1993). The FCC study is subjective; owners indicate how well they think design/build projects performed compared to how well they think similar traditional projects would have performed. The study indicates, however, that public owners perceive fewer change orders are necessary on design/build projects.

Objective studies. The CII study discussed in the previous issue evaluated the "Cost Growth" of projects based on the following equation:

Cost Growth = (Amount of Change Orders/Original Construction Amount)

where the amount of change orders is the cumulative dollar value of all changes approved during construction and the original contract amount is the total cost agreed upon between the owner and the contractor before construction. Figure 7 illustrates the cost growth for fixed price projects with different execution formats. For the 71 fixed price projects evaluated, the median value of cost growth was 5.3% (Zeitoun, 1993). Although the design/build projects experienced a lower overall cost growth than the average (4.6% versus 5.3%), they did not perform better than the design/bid/build projects included in the study.

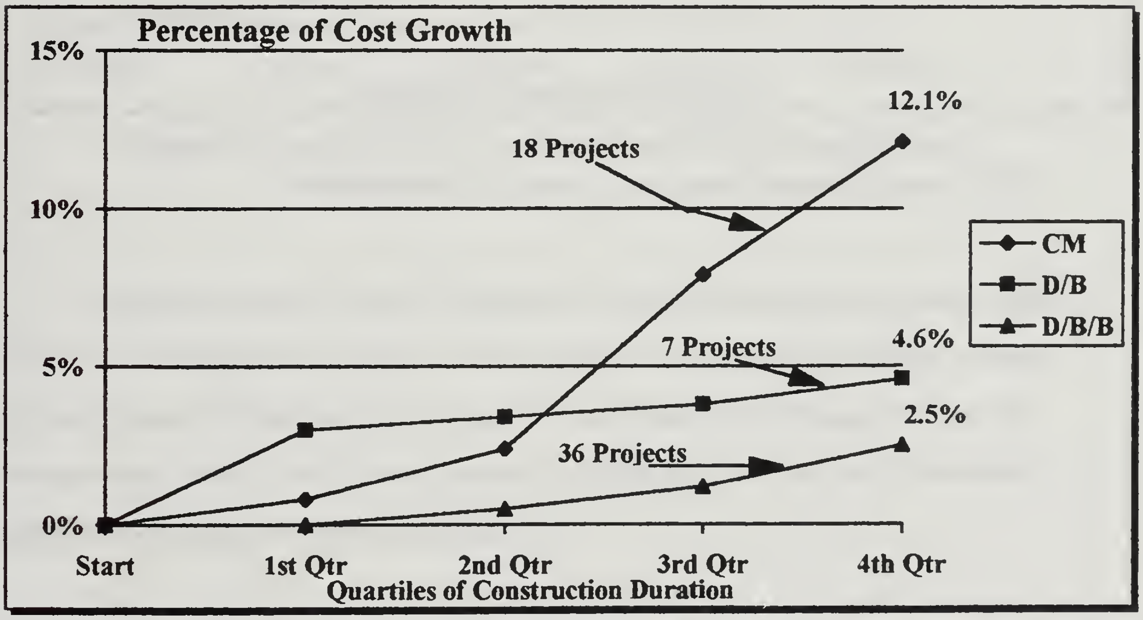

Figure 7. Cost growth for fixed price projects which were administered by different execution formats (Zeitoun, 1993).

Figure 8 is from the CII study and shows the cost growth for cost reimbursable projects using different execution formats. This data set contains 32 total projects and the median value of cost growth was 6.8% (Zeitoun, 1993). For the cost reimbursable projects, design/build projects performed better than all of the other delivery systems, but not by a significant margin.

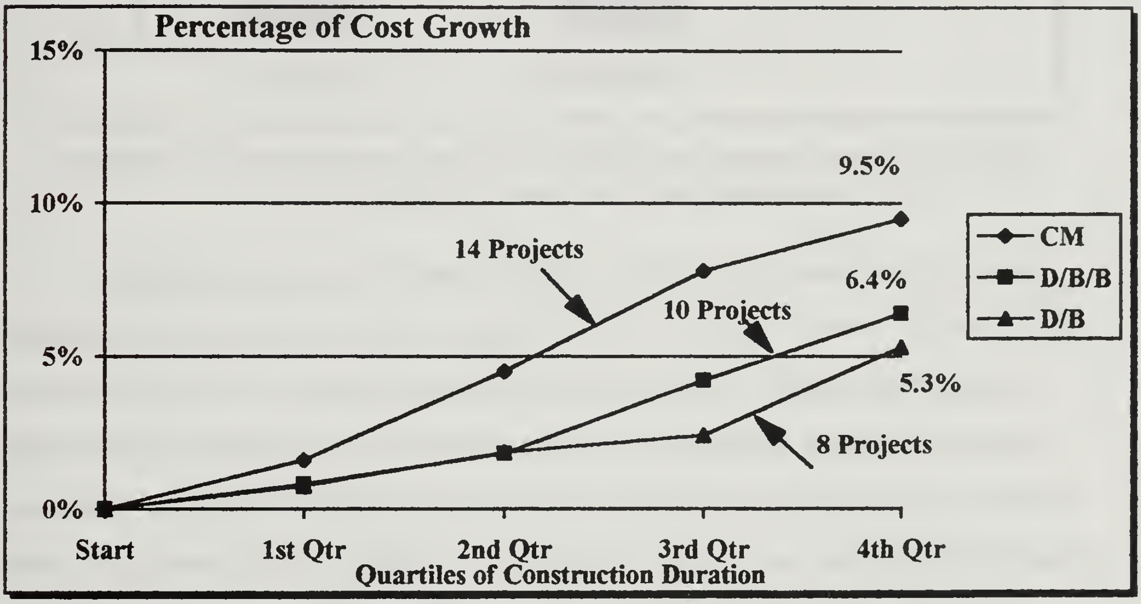

Figure 8. Cost growth for cost reimbursable projects which were administered by different execution formats (Zeitoun, 1993).

Mouritsen's study of Navy Child Care Centers reflected an improved change order rate on design/build projects when compared with traditional delivery system projects. Figure 9 illustrates the difference determined by Mouritsen between the change order rates for traditional contracts and design/build contracts. Mouritsen calculated the change order rate as follows:

Change Order Rate = (Amount of Change Orders/Original Contract Amount).

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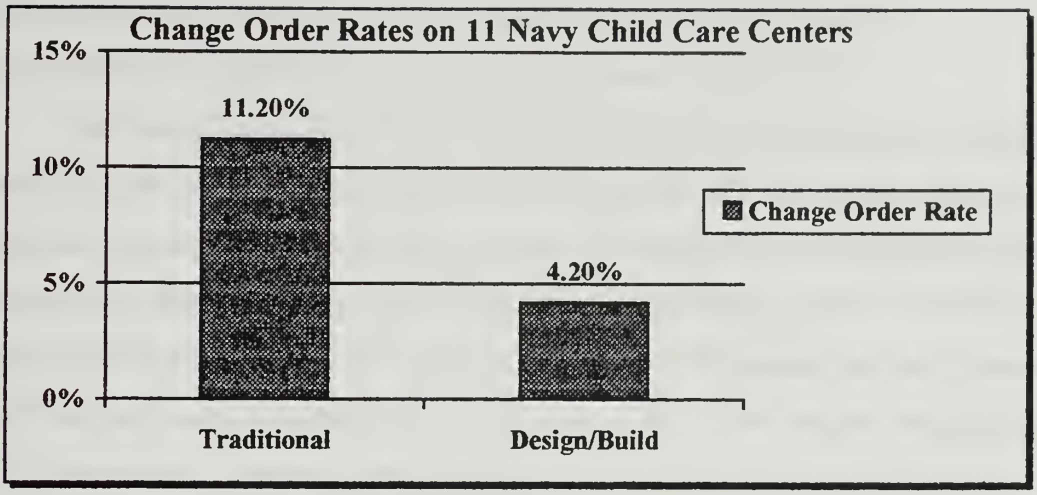

Figure 9. Change order rates for 11 Child Care Centers constructed by the U. S. Navy during Fiscal Year 1990 (Mouritsen, 1993).

Comparison of subjective and objective studies. Both quantitative studies demonstrate that, for all projects, design/build contracts have lower cost growth than the median. The FCC study indicates that owners perceive design/build projects perform much better than traditional contracts. The objective conclusions are not completely consistent with the subjective conclusions; design/build projects did have better cost control, but it is difficult to justify a conclusion that they performed *much better* than traditional contracts. The owner's perception may be based on the reduced administrative burden of executing changes or on the reduction of the number of design changes. The next issue addresses the potential for reduced administrative burden when design/build contracting methods are employed.

Streamlined contract administration

Mr. Verdelli is a professional in the food processing industry. When he needed a new facility constructed he wanted to make a contract, be informed of the construction progress, and advised of any problems or potential improvements. He did not want to perform administrative tasks of extensive correspondence between his firm and the designer and/or between his firm and the builder. Design/build contracting allowed him to stay abreast of the construction without extensive

administrative requirements. Verdelli considers the streamlined contract administration a “big plus” of the design/build process (Verdelli, 1995).

The United States Postal Service (USPS) has utilized design/build procurement methods for several years. According to John Wiernicki, Director of the Office of Design and Construction for the USPS, project administration for design/build projects is much easier than traditional contract administration (Denning, 1992). NAVFAC personnel have also indicated that the administration of design/build projects is easier than traditional contracts because the coordination between the designer and builder is largely eliminated. However, there has been some confusion among field personnel regarding responsibility for certain documents; how much authority is delegated to the contract administrators, etc. Experience with the process will clarify the requirements and individual responsibilities; only then will the true potential administrative savings be realized (Fiddler, 1995).

Design/bid/build contracts require the owner to correspond between the constructor and with the designer. They require two separate contracts to be administered and any differences between the designer and the builder must be resolved with the owner’s assistance. With the single contract in design/build procurements, the owner deals only with the design/build team leader. If questions develop regarding construction details, the design/build team must resolve the problem internally. Design/build projects require administration; letters are written, changes are negotiated and approved, payment requests are processed, carpet, wallpaper and paint samples are selected, etc., even so, the administrative process is simplified considerably.

Summary

The formulation of the design/build contract influences how the project will be administered, how much flexibility design/build teams have during construction, how much input owners have on the construction process, etc. Once the contract is awarded, the design is completed and the construction starts. For both the owner and the design/build team, timeliness becomes very important once the process begins. Decisions made after the project starts may have significant cost impacts and changes may be very expensive, especially if fast-track scheduling is employed. Information should be processed quickly by all parties and communication should be enhanced by the simplified organization inherent to the design/build delivery system. Designers may be pressured by constructors to complete design elements and reviews quickly, but the architects and engineers must ensure that the design integrity is maintained and public safety is not compromised. Post-award issues are the most exciting elements of construction; a thorough understanding of post-award issues and an appreciation of different perspectives will help construction professionals complete better projects with less conflict and improved satisfaction for customers and construction professionals.

Chapter 4.

Issues Unique to Federal and Other Public Contracts

Introduction

Taken collectively, the Federal Government is the largest construction client in the country, spending approximately $42-billion per year on various construction projects (Nesmith, 1994). As the guardian of public funds, public owners are frequently cautious in trying new systems, particularly in construction contracting. This caution is occasionally due to legislation or administrative rules, but may also be a simple reluctance to change. This reluctance can be found in private owners as well, but is especially common in large bureaucratic organizations (like the government) which are not profit driven. This combined effect of resistance to change and regulatory constraints has caused the public owner to be several years behind the private sector in design/build experience. NAVFAC, USPS, GSA, National Aeronautics and Space Administration (NASA), and the U. S. Army Corps of Engineers (COE) have all awarded design/build contracts over the last few years with varying success rates, and all these organizations are looking to expand their use of the delivery system.

GSA has the most experience of any of the public sector agencies, starting their design/build program in the mid 1980's with large facilities including court houses, office complexes and health care administration facilities. Of the federal owners, GSA also has the largest annual budget for construction, spending nearly $1.2-billion per year on design/build ventures (Nesmith, 1994).

During the middle 1960's, NAVFAC used design/build exclusively for family housing contracts. With increased procurement flexibility, NAVFAC has since awarded contracts for the renovation of existing facilities and for the new construction of barracks buildings and Reserve Centers in the Northeastern United States. Similarly, the COE started their design/build program in housing, yet they too have

expanded in recent years, completing over thirty projects since 1986 (McManamy, 1994). The USPS has employed design/build contracting on approximately five projects per year with good success (Nesmith, 1994).

All the agencies mentioned have had successful and unsuccessful projects, and all have documented issues that are somewhat unique to public agencies. This is not to imply that public owners are insulated from the previously mentioned issues; quite the contrary is true. Public owners are faced with nearly all of the private contracting issues plus the issues which follow. Before an analysis of the specific issues, an introduction of the Brooks Architects-Engineers Act and Title 10, Section 2862 of the United States Code is in order. After a discussion of the legislation, the following specific issues will be addressed:

- *Fair and Equitable Proposal Evaluation Process*
- *Design and Construction Funds Authorized in Different Fiscal Years*
- *Lack of a Standard Design/Build Contract Format*
- *Inability to Respond to "Bid Busts"*
- *Signature of Final Design Drawings*
- *Lack of a Centralized Listing for Lessons Learned*

Brooks Architects-Engineers Act (40 U. S. C. SS 541)

The Brooks Architects-Engineers Act of 1972 (Brooks Act) requires contracts for design services on federal projects be awarded based on factors other than cost, yet still be for a reasonable price. The law is intended to protect the public safety by ensuring that public facilities are designed by experienced, competent design professionals. Numerous articles have implied that the essence of the Brooks Act precludes the Federal Government from fully utilizing design/build contracting. Mr. Michael C. Loulakis writes in the *Design-Build Contracting Handbook:*

> "Public owner's face a number of constraints in their procurement of design and construction services. The Brooks Architects-Engineers Act (The Brooks Bill), for example, requires public owners to procure design services on all federal projects without price competition (Cushman, 1992)."

Mr. Loulakis further states that federal design/build projects are completed only through specific statutory amendments or through complicated exceptions. Based on field inquiries, federal construction professionals do not agree with Mr. Loulakis' statements which indicate that public design/build projects require special legal exceptions and specific amendments. Federal owners are utilizing design/build contracting methods more frequently and with increased flexibility.

Mr. Fiddler, of NORTHDIV, is sensitive to the Brooks Act requirements, but notes that the Navy's design/build solicitation documents do not specify how the designer is to be chosen. Even when the solicitation is in the "Newport Design/Build" format, the selection criterion for the design professional does not refer to the cost of design services, only to quality requirements and the overall project cost. The "Newport Design/Build" format is a sealed bid solicitation resulting in a firm-fixed-price contract awarded to the lowest, responsive, responsible bidder. In this case the successful bidder must complete the design with competent, experienced, professional designers, but the designer is frequently treated like any other sub-contractor on the project. Mr. Fiddler further notes that in his experiences, it is not in the bidder's best interests to hire the least expensive designer, because the prime contractor is ultimately accountable for the success of the finished project. Correcting the construction mistakes attributed to a poor design can be far more expensive then the total cost of the designer's sub-contract (Fiddler, 1995).

Although the Brooks Act deserves consideration when developing design/build contract documents, it does not represent a significant hurdle to the future of federal design/build procurements.

Title 10, Section 2862 of the United States Code

In 1984 Congress publicly expressed concern over seemingly high cost estimates for relatively simple military construction projects. The Department of Defense was encouraged to explore creative approaches to contracting which may result in reduced costs. To support the military departments, legislation was prepared to authorize alternative contracting methods. One section was specifically written in support of "turn-key selection," which is another term for the design/build delivery system.

Originally enacted in October 1986, Section 2862 of Title 10, United States Code is entitled, "Turn-key Selection Procedures." As the law was written in 1986, the secretaries of each military branch were authorized to enter into three design/build contracts per fiscal year, and each contracting action required approval from the Secretary of Defense. A 1990 revision of the law eliminated the Secretary of Defense approval requirement. Not until a 1991 amendment was enacted was the three-contract-per-fiscal-year-limitation removed (Title 10, U.S.C. Section 2862). The 1994 edition of the COE's, *Design-Build Instructions for Military Construction,* cites this legislation as authority to enter into design/build contracts (Stevens, 1994). Although unsigned as of this writing, the NAVFAC authored, *Policy and Procedures for the Newport Design Build Process,* also traces authority for design/build contracting to this section of the United States Code (MIL-HBK-1006/5, 1994). With such restrictive legislation, it is not surprising that the military branches were the slowest among the federal agencies to effectively utilize design/build contracting methods.

Issues

Fair and Equitable Proposal Evaluation Process

Public projects are subject to especially close scrutiny because the funding is provided from taxpayer dollars. Consequently, high level reviews of the award process are not uncommon, and a Congressional Inquiry can be especially time consuming for a field office trying to award and administer multiple contracts. To ensure the awarding procedure is above reproach, a fair, clearly communicated evaluation process must be utilized when considering proposals.

During a January 1995, design/build workshop at NAVFAC Headquarters, the leading issue addressed by field division personnel was a need for guidance on technical evaluations when source selection procedures are employed. Part 14 of the Federal Acquisition Regulations (FAR) outlines procedures for technical proposal review, but evaluation of design/build proposals is not a common occurrence at most field offices. Adding to the difficulty, the FAR language does not specifically pertain to design/build procurement actions. As pointed out in the COE's, *Design-Build Instructions for Military Construction,* design agency contracting officers commonly review architectural proposals, but construction agency contracting officers are more experienced in sealed bidding procedures, so a combined design and construction proposal creates some special challenges for the review team (Stevens, 1994).

Proper preparation of the solicitation is the most critical step to ensure that an equitable review is completed, and the award goes to the best proposal. Minimal quality standards and other critical elements must be clearly established in the solicitation package, but the relative importance of each element must also be stated for public projects. A well organized solicitation avoids ambiguities for the evaluation team and results in a fair contract award which will withstand close scrutiny from any review. Also, if proposers understand what is required, they will be less likely to

dispute the outcome, and they will provide a proposal consistent with the agency's desires.

Although a leading concern for field division personnel, a consistent, fair and equitable proposal evaluation process can be developed with higher level guidance and open exchange of lessons learned between public owners. A more extreme solution to the issue is increased utilization of NAVFAC's invitation for bid procedures, where selection is based solely on the lowest bid. Although a sealed bid process avoids the source selection issue, it limits the owner's ability to technically review the proposals and score elements of the design other than cost, which is an advantage of the design/build delivery system.

Design and Construction Funds Authorized in Different Fiscal Years

An unusual issue regarding project funding is addressed by both NAVFAC and the COE in their respective design/build guidance (Stevens, 1994 & MIL-HBK-1006/5, 1994). This funding issue was not addressed in the publicly available literature, but due to the nature of federal funding, this issue should also apply to other federal agencies. Traditionally, federal defense appropriations authorize design funding for a military construction project in one fiscal year and the construction funding in another fiscal year. Currently, for design/build projects, the authorized design dollars are used to develop the solicitation package, which generally costs far less then the funds available. Due to federal budgeting procedures, the left-over funds can not be carried forward to augment the construction funds; therefore, the left-over design money typically goes unused. The total design/build contract is then funded with the construction appropriation. To date this arrangement has been successful, which speaks well for the overall cost savings realized with the design/build process, but limited contingency funds are available for the construction project. There is the potential, however, that this arrangement may result in failed procurements if cost overruns are encountered due to differing site conditions or other unanticipated, changed circumstances.

This funding issue is currently addressed as a problem of the design/build delivery system, but must be considered in perspective of the overall acquisition procedure. Currently projects for NAVFAC are identified as design/build candidates late in the acquisition process. All of the initial planning paperwork is submitted early in the project's life, which identifies the need for the facility and specifies the basic requirements, but nowhere in that initial paperwork is the project identified as a potential design/build candidate. This issue can be handled by the base facilities officer, if the project is identified in the initial planning documentation as a potential design/build candidate. If identified early, all of the estimating figures will be based on the design/build delivery system. Acquisition planning will accurately reflect the costs associated with solicitation preparation, and total design/build costs plus appropriate contingencies will be included in the construction authorization. With proper planning, this issue should cease to be a concern for federal owners in the near future.

Lack of a Standard Design/Build Contract Format

Another issue high on the list of concerns from field division personnel at the January 1995, design/build workshop at NAVFAC, was the lack of a standard solicitation package for design/build procurements. Although every federal project is unique, a standardized solicitation package will allow prospective bidders, contracting officers and contract administrators to become familiar with the basic of components of design/build contracts. The National Society of Professional Engineers also addressed this issue regarding a lack of standardized contract requirements in their recent discussion paper about design/build in the public sector (Worischeck, 1994).

With the evolution of design/build contracts, the solicitation format has changed frequently. The changes in submission requirements can confuse proposers and frustrate federal employees responsible for contract award and administration. The changes in the solicitation package are intended to simplify the procurement process and/or to apply lessons learned from previous projects (Fiddler, 1995).

Despite these good intentions by public owners, proposers must be aware that the solicitation packages currently are not consistent for design/build projects.

With more experience in utilizing the design/build delivery system, public owners will be able to standardize the proposal requests to a few basic formats. There is no better advice than to read the entire contract before submitting a proposal; but realistically, as construction professionals gain familiarity with the standardized solicitation packages and contract documents, the lack of a standard solicitation and contract will become less important.

Inability to Respond to "Bid Busts"

The previously addressed FCC report, *Experiences of Federal Agencies with the Design-Build Approach to Construction,* states in part:

> "For nine of the (27) projects reported on, the primary reason given for the use of the design-build approach was to save time (Beebe, 1993)."

The emphasis on time was also expressed in numerous interviews with federal owners (Ferrari, 1995; Fiddler, 1995 & Spaulding, 1995). As previously addressed, improved timeliness is a major advantage of the design/build process, but there is one scenario where design/build may be unable to satisfy the public owner's requirements.

A typical scenario is that the construction funding for a project is suddenly approved half-way through the fiscal year, but the project design may not be complete. To ensure that a construction project can be awarded, the partial design is used as the backbone for a solicitation package, and the acquisition becomes a design/build procurement. Frequently the authorized construction funds must be obligated in the current fiscal year, which requires a contract award by the last day of the fiscal year. This sequence of events has occurred several times in the past three years within NAVFAC. Usually the contracts are awarded on time and the successful project is completed with limited fanfare. However, if the proposals received exceed the funds

available ("Bid Bust"), the award can not be made. The project is then placed on indefinite hold as the funds expire. If more time was available in these scenarios, the process may be able to accommodate discussions with the bidders, or the solicitation could be revised and re-advertised in the hope of successfully awarding a contract.

This criticism of the design/build process seems unwarranted, because the root cause is either a lack of planning or inflexibility inherent to the public funding process. Regardless of the basic reason, in this situation there is no standardized contracting process which would allow for a successful contract award.

Signature of Final Design Drawings

Liability and ownership of the final design is a complicated issue in all design/build projects. Chapter 5 of this thesis will list several related issues, but one liability issue that public owners are especially sensitive to is final approval of the design/builder's construction drawings. Generally federal owners retain a third party designer to prepare the solicitation package and review the final design documents. Occasionally federal owners utilize "in-house" designers to prepare the solicitation documents and review the contractor's submittal. In traditional contract arrangements, the design professional who prepares the solicitation package is the designer of record and their registration stamp appears on the design documents. With design/build, however, the third party designer is simply expected to review and comment on the final design, without signing an approval or "satisfactory to" block on the drawings. Clearly the designer who prepares the final design documents is ultimately responsible for the design, but does the third party designer accept some of the liability when they review the submittal?

Although unsigned, the NAVFAC policy statement places accountability on the design/builder for all technical aspects of the final design. The third party designer is paid to review the drawings prior to government approval, but the third party designer's accountability for the finished product is not defined. The government representative signs the final drawings in a standard approval block, but that approval

is for functionality and indicates that the design will satisfy the owner's requirements. The third party designers have expressed concern over this arrangement, and have been particularly sensitive when asked to sign anywhere on the design/builder's drawings (Fiddler, 1995).

The COE guidance requires that the government approve the design/builder's submittal, but there is a disclaimer that the approval does not relieve the contractor of any liability for errors or omissions in the design. The COE guidance does not address the third party designer's responsibility for final design review (Stevens, 1994).

This issue was discussed extensively during the NAVFAC workshop in January 1995, without resolution. One plausible suggestion was to include a special "satisfactory to" block for the third party design professional to sign with an appropriate disclaimer. The NORTHDIV attorney present during the conference agreed to review the possibility of a special signature block and disclaimer, but as of this writing, no resolution has been documented. To date there is no substantial case law to establish a precedence on the designer's liability for public design/build projects when a third party designer is employed. This liability issue will not be resolved quickly, and unfortunately may take several bad experiences to define the true responsibilities of the various participants in the design/build process.

Lack of a Centralized Listing for Lessons Learned

Perhaps it is not an issue unique to design/build contracting methods, but the lack of a centralized data base for lessons learned on public, or at least federal procurement actions, is an issue worth noting. NAVFAC is divided into four field divisions and six field activities. Each of the field divisions and activities have essentially complete contracting authority; they prepare, advertise, award and administer contracting actions within their respective regions. Successes and failures occur independently with reports forwarded to NAVFAC Headquarters. Personnel at Headquarters attempt to disseminate the information between the field divisions and activities, but the distribution medium does not reach all levels of the organization.

Learning from other's mistakes is an easy and painless way to learn valuable lessons, yet within NAVFAC an effective dissemination process has not been developed. The COE and GSA are both much larger than NAVFAC, and annually the COE, GSA and NAVFAC collectively spend billions of dollars on design/build projects. Despite these huge cash outlays, a centralized repository of lessons learned has never been established. Several field division personnel commented that this is an important issue, especially in light of rapidly developing contracting mechanisms like design/build.

Mr. Narula described an exhaustive data base of important issues and lessons learned utilized by Bechtel Power Corporation. When a new project starts, he reviews the appropriate comments from previous, similar projects regarding successes and failures, and he requires his managers to do likewise. This quick review of past experiences sensitizes the team to potential issues which may be encountered during the new project, and demonstrates how similar issues have been handled in the past (Narula, 1994).

Bechtel's system was not developed overnight, but has proven to be an effective tool for the organization. Federal procurement authorities should seek to improve inter-agency communications. Lessons learned should be lessons shared and perhaps mistakes will be repeated less often.

Summary

The two pieces of legislation and six issues addressed here represent the most significant issues unique to federal design/build acquisitions. Other topics are discussed in the various manuals and many more topics were addressed during the January 1995 workshop held by NAVFAC. Most of these issues will be resolved as the federal sector gains experience utilizing the design/build delivery system, but several will take time to be fully understood. It is noteworthy that many of the same issues are addressed by different agencies within the Federal Government, yet organized interaction between the various agencies is very infrequent. Learning from each other through improved inter-agency communications will significantly enhance the public sectors ability to effectively make use of the design/build delivery system.

Chapter 5.

Other Issues

Introduction

The issues addressed thus far have been categorized chronologically (Chapters 2 & 3), or have been presented from a specific perspective (Chapter 4). The issues in Chapter 5, are not easily categorized since some relate to local or state laws or regulations, some are financial concerns unique to design/build projects or they are issues that present a unique legal or personal perspective. The discussions accompanying these issues are brief; the intent in this chapter is to simply present the issues for consideration. The following issues will be discussed:

- *Designer's Liability Insurance May Not Cover Design/Build Ventures*
- *Builder's Insurance May Not Cover Errors and Omissions of Design/Build Ventures*
- *State Legislation/Regulations Are Inconsistent From State to State*
- *Bonding Problems May be Encountered by Design/Builders*
- *Construction Loans May be Difficult For Owners to Acquire Without a Design*
- *Improved Warranty Coverage Should be Realized*
- *Owners Settle In a Split Claim Between the Designer and the Builder*
- *Subcontractor's Role Can Become Complicated With Design/build Contracts*
- *"Money and Time versus Proper Execution and Liability"*
- *Better Fees for Designers*
- *Limited Case Law to Establish Legal Precedence*

Issues

Designer's Liability Insurance May Not Cover Design/Build Ventures

Designers are frequently insured against errors and omissions during traditional contracting procedures. The insurance protects designers from direct financial liability if there is something wrong with the design. If re-work is necessary on the construction site due to an error in the designer's work, a claim against the liability insurance will pay for the construction related costs. In traditional contracting the architect is,

> "insulated from responsibility for construction means, methods, techniques, sequences and procedures; construction safety precautions; and errors and omissions of the contractor, because the contractor is performing these services," (Cushman, 1992).

If designers are the prime contractors in a design/build relationship, they are exposed to all of their traditional liabilities, plus all of the liabilities from which they are normally insulated. The design professional will be liable for the construction work and any failures in workmanship or non-compliance with building codes. Designer liability insurance usually excludes the construction process, so special policies must be procured to protect the design professional (Cushman, 1992). The design/build team and the owner must be aware of this potential shortfall in the designer's traditional insurance coverage and ensure that proactive measures are taken to protect all parties.

Builder's Insurance May Not Cover Errors and Omissions of Design/Build Ventures

Builders normally procure general liability insurance for construction operations, but that insurance does not protect against errors and omissions of the design. Builders who are the prime contractor on a design/build project must obtain insurance to cover errors and omissions. The requirement for builders who are prime

contractors to obtain errors and omissions insurance is much like the issue described above which requires the designer who is the prime contractor to obtain general liability insurance for construction operations.

State Legislation/Regulations Are Inconsistent From State to State

Professional registration laws for architects and engineers are enacted by each state. Legislation regarding design/build contractual relationships, therefore, varies from state to state. For example, the Commonwealth of Pennsylvania allows design/build contracting only when the architect is the prime contractor. Most architects lack the financial base to qualify for payment and performance bonds, so design/build contracting is less common in Pennsylvania than in other states. States like Florida, Maryland and California have no restrictions on design/build contractual relationships provided registered architects and/or engineers seal the drawings and licensed contractors perform the construction.

As noted by Kenneth Natkin, licensing laws differ across the nation. Generally registered designers must complete designs and licensed contractors must perform the building operations, but the way in which their relationship is organized for design/build acquisitions varies a great deal from state to state. Natkin advises all concerned to be cautious with state laws and ensure that all parties become well acquainted with the appropriate statutes, licensing regulations and possible requirements and identify the lead in the contractual relationships (Natkin, 1994).

Bonding Problems May be Encountered by Design/Builders

Payment and performance bonds are secured by contractors from sureties to protect the subcontractors and owner respectively. Payment bonds are purchased from a surety to pay unpaid subcontractors and/or suppliers in case the contractor becomes insolvent or simply fails to pay for services performed. Payment bonds also protect the owner because subcontractors and suppliers can place liens against the owner's property. The payment bond will ensure that the subcontractors and suppliers

are paid and any liens should be terminated. Performance bonds provide the owner assurance that if the contractor is unable to complete the project, the surety will stand behind the contractor's performance obligation, and the owner's project will be completed at the contract price (Sweet, 1994).

Sureties evaluate three "Cs" when they issue bonds: *Capital, Capacity* and *Character*. *Capital* is simply a measure of the liquid assets controlled by the party applying for the bond. Architectural firms rarely have the liquid assets necessary to secure high value bonds which frequently restricts their ability to act as the prime contractor on design/build teams. *Capacity* is the firm's organization: what the company's performance record has been, key personnel qualifications and experience, company policies regarding safety, contract administration practices, accounting procedures, etc. *Character* is the management skill of the firm: how well the team has evaluated the bonded project and developed appropriate strategies to mitigate financial and operational risk (Cushman, 1992).

Design/build teams may have difficulty demonstrating that they are a good risk for bonding companies. Bonding companies may have a difficult time assessing the risks of design/build ventures. Even if the surety does agree to issue bonds, they are frequently very expensive because of the uncertainties (Denning, 1992). Although payment and performance bonds may cost more for design/build projects, prudent owners will ensure that the contract includes requirements for the design/build team to secure them.

Construction Loans May be Difficult For Owners to Acquire Without a Design

Most private owners and some public owners finance construction projects using conventional construction loans from commercial banks. In traditional contracting methods, the loan for construction is secured after the design is essentially complete. A review of the design allows the lending institution the opportunity to evaluate the required building technologies and assess the financial risk of the project. In design/build contracts, however, the loan is secured before the design is complete,

precluding an advance review by the lender. Michael Loulakis is a construction lawyer in the law firm of Wickwire Gavin, P. C. Loulakis suggests that lenders consider hiring an independent party to review the progress, paying particular attention to potential overpayment issues (Cushman, 1992).

Improved Warranty Coverage Should be Realized

At the 1995 Partnership for Achieving Construction Excellence (PACE) Research Seminar, Preston Haskell of the Haskell Company stated that his firm was adopting five year warranties as the standard for its design/build projects. Mr. Haskell is confident that his firm can control the total construction process so well that a five year warranty will entice owners to utilize his firm's services without significantly increasing Mr. Haskell's risk. Although Mr. Haskell's promise of an extended warranty was not supported by all present at the PACE seminar, his comments describe a trend of increased confidence by design/builders that their projects can be built better than design/bid/build projects because of their control over the total construction process. Regardless of the warranty duration, problems which develop during the warranty period or as latent defects should be corrected by design/builder without conflicts regarding design errors versus construction practices. An example described in the next issue will illustrate the design/builder's obligation to correct deficiencies.

Owners Settle In a Split Claim Between the Designer and the Builder

Occasionally, traditional construction projects experience a latent defect which results in a claim by the owner against both the designer and the construction contractor. It is not uncommon in these circumstances for the courts to split the blame between the designer and the builder, which puts the owner in the difficult position of trying to collect from two separate parties. A recent case illustrates how design/build contracting can simplify the court process for owners.

An owner contracted for a three story office building. After completion, the roof started to leak, so the owner filed suit against the design/builder. The design/builder was a construction contractor and he brought the architect into the suit because he felt the leaks were caused by a faulty design. The court found that 25% of the problem was caused by the designer and 75% was caused by the builder. The owner was entitled to 100% of his claimed amount from the design/builder, which left the design/builder with the problem of collecting the 25% from the architect, *Rivnor Properties v. Herbert O'Donnell, Inc.*, 1994 W. L. 20967 (La App. January 12, 1994) (*Construction Owners News Briefing*, 1994).

The above example illustrates the sole source of responsibility with the design/build delivery system. Owners can be reassured that if they must go to court, there will only be one party against which to file suit; and regardless of who is to blame on the design/build team, the owner will be compensated if the owner prevails.

Subcontractor's Role Can Become Complicated With Design/build Contracts

The subcontractor's role on design/build contracts can be complex. If submitted during the project bidding phase, the subcontractor's proposal to the design/build team leader is based on a very incomplete design. Depending on the contract language between the subcontractor and the prime contractor, the proposal based on that partial design may be binding (Denning, 1992). If the subcontractor is bound by an initial bid, adjustments made during the final design process may result in costly overruns for the subcontractor.

The *Design - Build Contracting Handbook* states that subcontractors are "typically in the same relative position that they would be under traditional contracting mechanisms," (Cushman, 1992). Essentially this means that subcontractors work for the prime contractor and the prime contractor schedules and coordinates the work as they would on a traditional project. Shop drawings and other submittals should also be prepared the same way as on traditional projects.

Very few articles are published providing the subcontractor's perspective on design/build projects. With the exception of design professionals, field inquiries were not conducted with subcontractors for this paper. The subcontractor's role can be more complicated on design/build projects than it is on traditional projects. Although owners do not control subcontracts, they should be aware of the practices and associated risks because owners can be exposed to liens and other difficulties if the design/builder does not treat subcontractors equitably.

"Money and Time versus Proper Execution and Liability"

One comment made during the field inquiries for this paper requires specific attention. Designers have universally expressed concern about the design/build delivery system. They feel they are pressured for rapid action, they are concerned about their loss of direct interface with the owner and they are concerned their integrity may be challenged because they are financially committed to the construction outcome, etc. One architect summarized the designers' concern by stating that construction contractors work under an ethic that stresses time and money. Construction contractors want to work quickly, move from one project to the next without delay and maximize their profit margin wherever possible while still providing a finished product which complies with the quality standards specified in the contract documents. Designers on the other hand work under an ethic that stresses proper execution and liability concerns. Most architects are concerned with the integrity of the design; they want the buildings to project a certain image and to be unique. Designers are concerned about liability if the construction fails due to a design error, therefore, they scrutinize construction practices to ensure that the loads and stresses applied to the actual components are consistent with the design calculations and assumptions. Design/build contracting forces these apparently conflicting ethics to merge (Cramer, 1995).

Better Fees for Designers

Joe Shaffer is the president of Facilities Design, Inc. Mr. Shaffer attributes the higher fees received by architects on design/build projects to two reasons. The first reason is that the architect accepts more risk. Designers are pressured to work faster and more efficiently when involved in design/build projects. The construction schedule frequently relies on rapid designer actions to complete construction drawings or submittal reviews. The second reason for higher design fees is the relatively low cost of architectural services when compared with the expensive construction related activities. During negotiated procurements, the owner's attention is drawn to the high cost items like concrete, steel, complete mechanical systems and electrical components. The relatively low dollar value of the design services allows the architect's fee to be approved with minimal effort to negotiate the price down (Shaffer, 1995).

Mr. Shaffer is probably correct with his summary; designers do accept more risk, regardless of their contractual arrangement. When acting as the prime contractor, the architect controls the entire construction process and a higher fee accompanies the large increase in responsibility and corresponding risk. When acting as a subcontractor or consultant to the builder, the architect's risk is higher because of the constrained schedule which typically accompanies design/build ventures. Additionally, design fees are relatively small when compared to major construction elements, and it is natural for owners to negotiate the high dollar value items more aggressively, because larger cash returns can be obtained by a small percentage of concession by the design/builder. For example a 5% concession on a $10,000 line item for concrete results in a cash return of $500, while a 10% concession on a $2,000 line item for design services results in a return of only $200. In this example twice the concession results in less than half the cash return.

Limited Case Law to Establish Legal Precedence

The modern design/build delivery system is a relatively new construction process. As illustrated in Figures 1 and 2, It has gained popularity steadily over the past twenty years, but it still only accounts for approximately one-third ($^1/_3$) of construction dollars spent. Case law, therefore is limited, so very few legal precedents have been established which are unique to design/build contracts. The *Design - Build Contracting Handbook* provides opinions of various legal professionals regarding predicted outcomes, but very few specific cases are cited to support the assertions made. Legal precedence provides parties with a sense of assurance regarding outcomes in case of legal battles. Lawyers are better able to predict how a court will rule if a case with similar circumstances has already been judged. This lack of case law adds to the risk of design/build contracting, but it should not deter its use under appropriate circumstances.

Summary

Chapter 5 presents a brief discussion of issues which are not easily categorized chronologically. Bonding, licensing, insurance and financing issues can be extremely complicated and may be governed by different rules and regulations throughout the country. Contracting parties engaged in design/build projects should become familiar with the local regulations which govern these complicated issues.

Chapter 6.
Summary, Conclusion and Recommendations for Further Research

Summary

The design/build delivery system is a reemerging construction contracting process which has gained increasing favor over the past twenty years in both the public and private sector. This thesis provides an overview of the issues which surround the design/build delivery system. The discussions of the issues are intended to provide construction professionals with a basic understanding of the concerns and advantages of design/build contracting procedures. Through a process of reviewing available literature and conducting field inquiries with owners and construction professionals currently engaged in design/build ventures, multiple viewpoints are presented for each issue. A review of the accompanying risks for the issues is also provided. A basic understanding of the issues and surrounding risks is essential to maximize the effectiveness of the design/build delivery system.

Conclusions

This thesis is intended to provide a systematic overview of a process with discussions of specific issues. The research has resulted in a relative consensus on some aspects of the design/build process. The conclusions presented are a listing of those elements which construction professionals and owners agree upon as advantages of the process, required elements for a successful project and when design/build is an appropriate or inappropriate delivery system.

Despite varying viewpoints, several advantages of the design/build delivery system have consistently been presented by owners, builders, designers and literature sources. The Following represent the five most widely acknowledged advantages of the design/build contracting system:

1. Single source of responsibility/accountability.
2. Improved schedule control and the ability to fast-track the construction process.
3. Decreased change order rate (actual or perceived).
4. Decreased overall cost of construction.
5. Decreased administrative requirements.

In addition to the advantages of the system, the construction industry is in general agreement with the key success factors which are necessary for a successful design/build project. Following are the three most important elements:

1. Strong design/build team with an experienced professional as the team leader.
2. Open and frequent communication between the design/build team and the owner.
3. Well defined project scope in the initial solicitation.

Design/build projects were at one time limited to routine projects like parking garages, warehouses, basic office facilities and other simple, plain exterior and frequently repetitive, construction projects. Recently its use has been expanded to more complicated facilities like courthouses, libraries, child care centers and other buildings which are unique and attractive. The U. S. Navy has also used design/build contracting for major facility repair and a complicated project in England used a design/build project to refurbish the Oxford University Press without loss of service to

the printing business (Jones, 1993). Despite expanded use of the delivery process, it is agreed that design/build contracting methods are not perfect. The design/build delivery system, with a firm fixed price or guaranteed maximum price, is appropriate when:

- Owners can clearly define the project requirements (scope).
- Industry standard quality is required.

The design/build delivery system, with a firm fixed price or guaranteed maximum price, is not appropriate when:

- The project scope is not clearly defined.
- Higher than industry standards quality is required.
- Unique aesthetics are required.

Recommendations for Further Research

All of the issues presented in this thesis include brief overviews of complicated concerns. Any of the issues presented can be used as a basis for further research. The following specific areas are recommended for further detailed research:

1. Viewpoints of subcontractors regarding the issues presented.
2. Viewpoints of legal professionals regarding the issues presented.
3. Detailed evaluation of risk shifting contract clauses used throughout the design/build process.
4. Compilation and segregation of case law determined thus far.
5. Bonding trends which develop as the design/build process becomes more and more accepted throughout the construction industry.

6. Insurance trends which develop as the design/build process becomes more and more accepted throughout the construction industry.
7. Mot successful arrangements for design/build teams, and reasons for the arrangements success.
8. An evaluation to compare the standard design/build contracts available from various professional organizations (AIA, Engineers Joint Contract Document Committee, etc.).
9. An evaluation of project safety records on design/build projects compared to traditional projects.
10. Determine the optimal design effort necessary for owners to complete before the design/build solicitation is advertised.

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Appendix A.

Field Inquiry Questionnaire
&
Field Inquiries Conducted

Field Inquiry Questionnaire

1. What is your firms basic philosophy for getting work?
    * Is it consistent?

2. How is the relationship between the owner and the design/builder formalized?
    * Is it truly a single point of contact?
    * What is the frequency of interaction with the owner's representative?
    * What is the sophistication of the typical owner?
        - Contracting knowledge?
        - Familiarity with *your* contract?
        - Technical knowledge of engineering or construction?
    * What elements can cause the relationship to go sour?

3. What is the relationship between the Design and Construction Team members?
    * How is it established?
        - Formalized?
        - Contractual?
    * Are both teams from in house?
    * Do both teams spend time in the field together?
    * Does the team stay together from start to finish on most projects?
    * Is each design really unique?

4. How would you quantify your success ratio? (projects bid to bids won)

5. How much does it cost to prepare a set of bid documents?

6. Is cash flow a problem on Design/Build projects compared to traditional contracts?

7. How does a Design/Build project effect the overall schedule?
    * Firm completion dates?
    * Does the design/builder have better control over the schedule?

8. Have you seen more or less incentive/liquidated damages clauses with Design/Build compared to traditional contracts?

9. What sort of complaints have you heard from other team members?
    * Designers lamenting about a loss of contact with the owner.
    * Builders lamenting about working so closely with designers.

10. How much public work do you do? (percentage or dollar value)

11. How much private work do you do? (percentage or dollar value)

12. What are your thoughts on designer's fiduciary relationships with owners/clients?

13. What do you think the top issues are for design/build contracting?

14. How does the design/build delivery system affect innovation and creativity with problem solving both in the field and during the design phase?

15. Do you have any thoughts on the traditional approach's checks and balances?
    * Are they important?
    * Are they missed in Design/Build?

16. Is risk shifted away from the owner?
    * Do owners get what they want?
    * Do owners get what they describe?
    * Is it a function of meetings and discussions?

Field Inquiries Conducted

Private:

Owner:

Charles Baker, Members First Federal Credit Union	14 March 1995
Dan Verdelli, Verdelli Farms, Inc.	1 March 1995

Designer:

Rob Cramer, Department Head, Facilities Design, Inc.	14 February 1995
Joe Shaffer, President, Facilities Design, Inc.	14 February 1995
Jack Stone, Project Manager, Facilities Design Inc.	14 February 1995

Construction Contractor:

Craig Dussinger, Bowser Construction Company	14 February 1995
Ram G. Narula, Bechtel	27 December 1994
Peter Nettleton, Heery Corp.	29 December 1994

Public:

Higher Headquarters:

Ford Chinworth, NAVFAC Design Division Head	31 January 1995
Phil Ferrari, U. S. Postal Service	10 April 1995
Vince Spaulding, NAVFAC Design/Build Division Director	30 January 1995

Middle Headquarters (Field Division Level)

John Fiddler, NORTHDIV Design/Build Lead Project Manage	5 January 1995

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